# DUAL-RADIO CELLULAR TELEPHONE AND METHOD OF OPERATION

## CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of United States Provisional Patent Application No. 60/506,331 filed September 26, 2003.

## FIELD OF THE INVENTION

[0002] This invention relates generally to the field of telecommunications and in particular to dual-radio cellular telephones and methods of operation. More specifically, it pertains to a cellular telephone that integrates further radio technology in a variety of operational modes in order to emulate wired (T/R) basic telephony. This dual-radio cellular system can generate dial tone, have multiple handset extensions, operate in cellular-only or radio-only modes as well as operate in full duplex communication between the two modes.

## BACKGROUND OF THE INVENTION

[0003] As cellular (wireless) telephony has evolved through the years, its impact on society cannot be overstated. Dominant wireless standards such as Advanced Mobile Phone Service (AMPS), Code Division Multiple Access (CDMA), Global System Mobile Communications (GSM), Time Division Multiple Access (TDMA), which were originally designed with voice calls in mind, are continually being revised and upgraded to support high speed data, including 3$^{rd}$ generation wireless standards (3G) and as such wireless communications based upon these and other emerging standards is playing an increasingly important role in everyday life.

[0004] This is due, in part, to the extensive features offered by wireless communications and because of the extensive geographic coverage provided by wireless service providers and the affordability of wireless service. Accordingly, the use of cellular phones continues to dramatically increase and many wireless users even have multiple cellular phones in addition to a wireline service.

[0005] In general terms, a cellular (wireless) network includes a number of contiguous cells each covering a small geographic area. In each cell a Base Station (BS) communicates with a numbers of mobile telephones using Radio Frequency (RF) signals. Each mobile phone is assigned a pair of frequencies, called a channel, with the transmit frequency separated from the receive frequency by a number of spectrum units (Hz) depending on the particular wireless standard employed.

[0006] With some frequency spectrum variations employed in different countries, Base Stations and mobile phones operate in the 900MHz and 1900MHz frequency spectrum and conform to any of a number of the known wireless standards, for example, GSM, TDMA, CDMA, AMPS or other.

[0007] Wireline (wired) communications, on the other hand uses wires instead of radio links to connect a subscriber's telephone to, for example, the Public Switched Telephone Network (PSTN). In such a wired arrangement, a subscriber's telephone typically connects to the service provider's telephone switching system through an analog link that is sometimes also referred to as twisted-pair wire link.

[0008] As a variation to this wired communications, many subscribers use cordless telephones for added convenience of mobility within or around the home. Cordless telephones include a base unit and a handset unit in which the base unit connects to the analog line telephone jack while the handset communicates with the base over a wireless link. Such cordless links typically are analog 46/49MHz FM modulation links or digital spread spectrum in the 900MHz, 2.4GHz or 5.8GHz frequency spectrum. Newer formats, such as 802.11 and BLUETOOTH, are likely cordless candidates as well. As can be readily appreciated, cordless telephones offer the convenience of mobility along with the added flexibility of multiple handsets. Cordless telephones generally exhibit varying degrees of reception depending upon the distance from the base unit and its frequency of operation. Throughout this specification and claims, we generally refer to cordless links generically, as "radio" links and the terms are used interchangeably herein.

[0009] Cellular phones are designed not to exceed an emission limit of Radio-Frequency (RF) energy set by the Federal Communications Commission (FCC) in the US, the American National Standards Institute (ANSI) and other US and International Standards bodies. While these limits are based on safety standards set by the above standards bodies and confirmed by a mandatory radiation measurement test, called Specific Absorption Rate (SAR), having a cellular antenna in close proximity makes many users of cellular telephones uncomfortable. Such discomfort is exaggerated by reports of health concerns for users of cellular telephones.

[0010] Due to the benefits of each, wireless and wireline communications tend to compliment, rather than replace one another. In particular, many users are perplexed by the different, and oftentimes difficult human factors associated with cellular telephones. Furthermore, due to the small size of mobile cellular telephones, their use is often inconvenient, especially in situations where a single glance is necessary to locate a particular button or buttons on a keypad.

[0011] Cordless telephones, on the other hand, do not suffer from such negative health concerns because while cellular telephones typically transmit at a power level between 400 mW (milli-watts) to three (3) Watts - depending on the wireless technology used - cordless telephones transmit at a relatively low power ranging from only 1mW to 1W depending on the frequency of operation and modulation scheme thereby giving the comforting perception that the use of cordless telephones is "safer" than cellular telephones.

[0012] Due to the benefits of each, wireless and wireline communications tend to compliment, rather than replace one another. In particular, many users are perplexed by the different, and oftentimes difficult human factors associated with cellular telephones. Furthermore, due to the small size of mobile cellular telephones, their use is often inconvenient, especially in situations where a single glance is necessary to locate a particular button or buttons on a keypad.

[0013] Additionally, and unlike wired, plain old telephone system (POTS) tip/ring (T/R) analog or cordless telephony where a single telephone number/line can serve

multiple telephones, cellular telephones require a different telephone number for each cellular handset. As a result, even in situations where users can afford both wired and wireless services, it is nevertheless difficult or confusing for many users to have to remember which phone and number they require/are carrying.

[0014] Accordingly, numerous attempts have been made in the art to make cellular telephones easier to use while enhancing their functionality. In particular, United States Patent No. 6,351,653 B1 issued to Alberth et al., on February 26, 2003 for Cellular-Telephone with Simultaneous Radio and Cellular Communications describes a wireless communications system including a cellular telephone having both cellular and radio transceivers and one or more radios, in radio communication with the cellular telephone. The communication of the cellular and radio signals permits a cellular telephone user to participate in a radio communication and likewise permits a radio communication participant to participate in a cellular telephone communication.

[0015] Additionally, United States Patent No. 6,574,489 B1 issued to Uriya on June 3, 2003 for Incoming Call Notification Method and Device for a Multimode Radio Device, describes a multimode radio device that transmits and receives calls via radio signals of a plurality of communication modes that provides different incoming call notification according to the communication mode used.

[0016] The attempts in the art to improve mobile telephony have not ended there, however, as Verizon Avenue, a subsidiary of Verizon Communications, has announced a prototype for a hybrid cordless/cellular phone called Verizon ONE, that uses regular

telephone lines in the home and mobile networks when a caller is outside. (see, for example, http://wirelessadvisor.net/doc/12622) A chip in the phone converts from wired to cell service when subscribers move 300 feet from the home base station. From there, Verizon Wireless service picks up the signal.

[0017] Earlier, British Telecom attempted to release a phone that will serve as both a conventional cordless phone and a cell phone. The phone, named the BT OnePhone, allegedly allowed consumers to dispense with the expense and annoyance of having two phone numbers and two phones. While in a home, calls placed and received from the BT OnePhone were treated as cordless phone calls that are run through the conventional telephone network. Approximately 300 meters from the base station, the phone switched over to a GSM mobile network to become a cellular phone. Unfortunately, however, this phone dropped the call when the subscriber travels outside the range of the base station, as there was no seamless handoff.

[0018] Additional attempts to have cellular telephones operate like land-line telephones were described in United States Patent No. 5,960,363 which issued to Mizikovsky et al, on September 28, 1999 for "Tone Generating Apparatus For A Cellular Telephone To Simulate Tones Normally Sensed By A User Of A Land-Line Telephone". In particular, tone generating apparatus was provided in a cellular telephone to simulate tones normally sensed by a user of a land-line telephone.

[0019] Lastly, there has been considerable interest in the concept of dual mode GSM/DECT phones. Such phones allow the user to use the wide-area GSM cellular

network while out of an office or away from home, while also using the same handset at home or via the office PBX when in range of a DECT base station. (See, e.g, , http://www.dectweb.com/News&Views/Features/9906Dectweb.htm)

[0020] Accordingly, a need exists for telephony improvements whereby the advantages of both wireless and wired communications are offered to a user, without many of the noted disadvantages. Such an improved wireless/cordless telephone, method(s) of operation and associated devices are the subject of the present invention.

## SUMMARY OF THE INVENTION

[0021] I have invented a cellular/cordless telephone, method(s) of operation of same and associated devices for enhanced cellular/cordless telephony such that the individual benefits of wired/wireline, cellular, and cordless telephony are available to users of my inventive telephone(s), method(s), and associated devices.

[0022] Viewed from a first aspect, my invention is directed to a "stationary-mobile" telephone which simultaneously utilizes both wireless/cellular and cordless technologies in an easy-to-use package having both a base unit and one or more handsets.

[0023] Viewed from another aspect my invention is directed to a telephone employing cellular technologies that provides a familiar, audible dial tone to a user. Advantageously, such a telephone employing my inventive concepts may be either "stationary-mobile" as above, or a wireless "unmobile", which may remain fixed in location, but utilize cellular methods and apparatus.

[0024] From yet another aspect, my invention is directed to a cordless telephone that advantageously converts into a cellular telephone, depending upon a variety of selectable conditions such as signal strength or user preference(s).

[0025] Inventive methods are additional aspects of my invention, a first aspect being directed to a method of generating a dial tone and a method of eliminating the "send" function in a cellular telephone system.

[0026] An additional inventive method which is an aspect of the invention is a method of assigning the same cellular telephone number to two different cellular phones, as both perceived by the user of the telephone(s), and in a physical sense.

[0027] A method of reducing service costs by using wireless technologies to emulate both wired and coreless telephony is a further inventive aspect of my invention.

[0028] Advantageously, my invention minimizes exposure to RF radiation while utilizing cellular technology.

[0029] Additionally, my invention is directed to a method of remote alerting and out-of-range alarm systems to address the needs of the physically challenged or safety conscious.

[0030] Finally, my inventive methods are directed to methods of alerting the same cellular phone while calling two different telephone numbers and the selective direction of telephone calls to different cellular telephones.

[0031] Additional objects and advantages of my invention will be set forth in part in the description which follows, and, in part, will be apparent from the description or may be learned by practice of the invention.

## BRIEF DESCRIPTION OF THE DRAWING

[0032] Further objects of the invention will be more clearly understood when the following description is read in conjunction with the accompanying drawing in which:

[0033] **FIG 1** shows a Prior Art cellular network and corresponding cellular equipment;

[0034] **FIG 2** is a schematic representation of a stationary-mobile telephone according to the present invention;

[0035] **FIG 2a** is a schematic representation of a simplified cellular telephone according to the present invention;

[0036] **FIG 3** is a schematic representation of an un-mobile telephone according to the present invention;

[0037] **FIG 4** is a schematic representation of a stationary-mobile telephone in communication with several type-1 and type-2 handsets according to the present invention;

[0038] **FIG 4a** is a schematic representation of a dual, un-mobile telephone including a type-3 handset supporting type-1 and/or type-2 handsets according to the present invention;

[0039] **FIG 5** is a block diagram of my stationary mobile telephone or dual, un-mobile telephone according to the present invention;

[0040] **FIG 6** is a block diagram of a type-2 handset or duocell telephone having both cellular and cordless functionality according to the present invention;

[0041] **FIG 7** is a block diagram of a type-1 handset having a cordless functionality;

[0042] **FIG 8** is a flow chart depicting the method of a type-2 or type-4 handset manually or automatically switching from cellular to cordless modes and vice versa according to the present invention;

[0043] **FIG 9** is a flow chart depicting the method of operation of a type-2 or type-4 handset when approaching its base unit during an active call according to the present invention;

[0044] **FIG 10** is a flow chart depicting the method of assigning two different cellular telephones the same phone number according to the present invention;

[0045] **FIG 11** is a flow chart depicting an alternative method for assigning a single phone number to two different cellular telephones according to the present invention;

[0046] **FIG 12** is a flow chart depicting the generation of a dial tone in a cellular telephone according to the present invention;

[0047] **FIG 12a** is a flow chart depicting the operation of a cellular telephone having a secondary radio system according to the present invention;

[0048] **FIG 12b** is a schematic diagram of a cellular telephone having a secondary radio system activating a remote device during an incoming call;

[0049] **FIG 13** is a schematic diagram of an alternative embodiment of a telephone according to the present invention;

[0050] **FIG 14** is a schematic diagram of a base unit and multiple handsets depicting the dialing of the base unit producing ringing (alerting) in the multiple handsets according to the present invention; and

[0051] **FIG 15** is a flow chart depicting the steps associated with the scenario of **FIG 13**, above, according to the present invention;

[0052] **FIG 16** is flow chart depicting the steps associated with a call redirection when a user calls the base station of **FIG 14** and is redirected to one of the multiple handsets.

## DETAILED DESCRIPTION

[0053] By way of further background, and with reference now to **FIG. 1**, there is shown a prior art generic wireless system which may employ any of the wireless standards identified prior, that is, CDMA, WCDMA (Wideband CDMA), GSM (Groupe Special Mobile), TDMA (Time Division Multiple Access), AMPS (Advanced Mobile Phone System), PDC (Personal Digital Cellular), PHS (Personal Handy-Phone System), OFDM (Orthogonal Division Multiple Access) or others which are known in the art. As shown in that FIG.1, Base Stations **50-1**, **50-2** and **50-3** are connected to Cellular Switching Center **53**, which is further connected to the Public Switched Telephone Network (PSTN) **53**. As used herein, and as known generally, PSTN **53** represents the landline local or long-distance carrier's switching equipment that relay telephone calls from the base stations to landline or other cellular telephones.

[0054] Each base station covers a small geographic area, a cell (shown in **FIG 1** as **CELL A**, **CELL B**, and **CELL C**), and communicates with mobile terminals such as cellular telephones **52-1**, **52-2** and **52-3** using RF (radio frequency) signals in the 900MHz or 1900MHz frequency spectrum. In the cellular systems, a base station communicates with those cellular phones that are within its geographic coverage. For example, and as shown in FIG 1., base station **50-1** services cellular phones **52-2** and

**52-3**. If a mobile terminal moves geographically and enters a different cell, for example, **CELL C** to **CELL A**, a handoff of the cell phone is executed between the current base station **(50-1, CELL C)** and the base station situated in the cell that the mobile is entering (**50-3**, **CELL A**). Although not specifically shown in the figure, cellular phones could be located within structures such as houses **51-1** or office buildings **51-2.**

[0055] **FIG. 2** shows a **stationary-mobile-telephone 100** constructed according to the teachings of the present invention, which includes a base **700** and a handset **701**. While not specifically shown in the figure, it should be readily understood by those skilled in the art that the base **700** may serve more than one handset **701**. In particular, the number of handsets served by an individual base is limited largely by practical limitations, and not technical ones.

[0056] As used in its intended purpose, **stationary-mobile telephone** may serve as the primary telephone in the home or a small business. As such, this wireless telecommunications service – which is provided by a wireless service provider - may be the only telecommunications service subscribed to. Consequently, this exclusive use of wireless communications eliminates the need for wireline service thereby saving the subscriber additional expenses associated with subscribing to both wireline and wireless monthly charges.

[0057] With continued reference to **FIG. 2** and as can be readily noted, **stationary-mobile-phone 100** has the "look and feel" of a traditional cordless

telephone except for the distinct feature of having two antenna systems **168** and **169** in its base **700** and two antenna systems **177** and **178** in its handset **701**. It should be noted however, that a single antenna system in either the handset **701** or the base **700** is possible - depending on the particular frequency(ies) of operation. Additionally, while the antennas **168**, **169**, **177** and **178** are shown as external and visible by the user, they could be implemented to reside within the housings of the base **700** and handset **701** – thereby not being visible from outward inspection

[0058] According to the teachings of the present invention, the two antenna systems operate in different modes, cellular and cordless. Additionally, and as will be described in more detail later, the handsets can be of two types, namely a **type-1 handset** which only includes a cordless sub-system and **type-2 handset** which includes both cellular and cordless sub-systems.

[0059] With continued reference to **FIG. 2**, it is shown therein that the base of the **stationary-mobile-telephone 100** includes a cradle **161** into which the handset **701** can be placed when not in use and an LCD (liquid crystal display) **167** where menus, incoming call information, outgoing call information and other visual user notification information may be displayed. Soft key panel **166** may include a number of soft keys **165** which change function depending on the manus and options displayed on the LCD and the context, or state of operation of the telephone **100**. In addition, and as can be readily appreciated, optional features in base **700** (depending on the model) include keypad **164** with a number of buttons **162**, for example, twelve, along with a speaker **160** and microphone **163** for hands-free speakerphone operation. Although not

explicitly shown, if the speakerphone and representative 12-button keypad **164** were not included in a specific implementation, the base then would resemble a simple cradle suitable for storage, holding and charging purposes.

[0060] Unlike cellular phones, the stationary-mobile –telephone **100** provides the capability for an AC connection to the wall supply through plug **156** and an AC-DC adapter **157** which connects to the base **700** through connector **158**. Not explicitly shown in **FIG. 2**, but readily understood by those skilled in the art, is a battery back-up system which would be necessary during power outages.

[0061] According to my inventive teachings, the handset unit **701** can operate in conjunction with its base **700** or as a stand-alone cellular telephone - when it is a **type-2 handset** – while away from the base **700**. Conversely, a **Type-1 handset**, which is not wireless cellular but rather cordless, always needs to operate in conjunction with the base **700.**

[0062] It is believed that when configured in a preferred embodiment, one feature that distinguishes this handset unit **700** from the traditional cellular telephone is its large buttons **172**, bigger size and smaller LCD **175**. The handset unit **700** shown also includes keypad **171** having twelve buttons **172**, a microphone **170**, an earpiece (receiver) **176**, a soft key panel **173** along with a number of soft keys **180**.

[0063] As noted before when discussing the base **700**, Soft keys **180** are buttons that change function depending on the current setting of menu and other options

displayed on the LCD and the operational context of the unit. And although in this figure four soft keys are shown, any desired number of soft keys can be implemented depending upon such factors as the size of the LCD, size of buttons and overall size of handset.

[0064] According to my inventive teachings and as shown in **FIG.2** the handset unit **701** is a **type-2 handset** that includes a dual antenna system having one antenna **178** that communicates in cellular mode with the nearest cellular base station and another antenna **177** that communicates in cordless mode with the base **700**. An additional feature of my inventive type-2 handset is a manual switch **179** that can force the unit manually into cellular or cordless mode, as desired by a user. The dual LEDs (light emitting diodes) **180** provide the user with an indication of whether the handset is in cordless or cellular mode.

[0065] With reference now to **FIG. 2a**, there is shown a simplified cellular telephone, constructed according to my inventive teachings, which operates like a conventional cellular telephone and capable of supporting a variety of known cellular/wireless communications standards, i.e., GSM, CDMA, etc. As can be readily appreciated, this cellular telephone shown is extremely simple and should prove relatively inexpensive to manufacture.

[0066] Specifically, the simplified cellular telephone **300**, or simplicell, includes a 12-button keypad **372**, a microphone **370**, an earpiece receiver **373**, a talk button **373** and a cellular antenna **373**. As can be seen from the FIG. 2a, the buttons **371** are

generally larger than those of traditional cellular phones. The cellular antenna **373**, which communicates with the nearest wireless base station (BS), can also be internal to the unit and therefore and invisible to the user.

[0067] With reference now to **FIG. 3,** there is illustrated the external features of an alternative embodiment of our inventive cellular/wireless telephone, the **un-mobile telephone 300**. Telephone 300 also includes a base unit **268** and a handset **269.** It is intended and expected that such an **un-mobile 300** phone looks and feels like a conventional business or home phone.

[0068] In terms of functionality, the **un-mobile** phone **300** operates in a manner similar to a conventional cellular phone known in the prior art, but with the added ability to generate a dial tone and the further ability to connect to the AC wall supply **256** through an AC-DC adapter **257** and a connector **258** on the base **259**. Not specifically shown in **FIG. 3** is the battery back-up system which is necessary during power outages.

[0069] Base unit **259** includes speakerphone function having a speaker **260** and a microphone **263**, a keyboard **264**, a display **267**, and a soft key panel **266** with soft-keys **265**. As can be appreciated, these functions are similar to those described with reference to **FIG. 2**.

[0070] As a result of it being stationary, the base unit **259** connects to the handset **269** through a cord **253** and jacks **254** and **255**. In an exemplary embodiment,

the handset **269** may contain only the simple functions provided by a microphone **270** and an earpiece (receiver) **276**. This simple version of handset is herein called a **type-4** handset. Because the **un-mobile** phone **300** as depicted in **FIG. 3** operates only as a cellular phone, it only incorporates a single antenna **269** at its base **259**.

[0071] Turning our attention now to **FIG. 4**, there is illustrated how the base **800** of a **stationary-mobile-telephone** can be used with multiple handsets **801-1** ... **801-3**; and **820-1** ... **820-2**. As shown in **FIG. 4**, base **800** includes two antenna systems **868** and **869**, one for each mode of operation, cellular and cordless respectively.

[0072] As depicted in **FIG. 4**, handsets **801-1**, **801-2** and **801-3** are **type-1 handsets,** meaning that they only communicate via cordless methods and as such utilize a single antenna **877-1**, **877-2** and **877-3** respectively. Handsets **820-1** and **820-2** are **type-2 handsets** and as such they utilize both cellular and cordless methods and therefore include two antenna systems **877-4** and **878-1** in handset **820-2** and two antenna systems **878-2** and **877-5** in handset **820-1**. However, it should be noted that a single antenna system for use **in type-2 handsets 802-1** and **820-2** is contemplated if the frequency of operation of the cellular sub-system is sufficiently close in spectrum to the cordless frequency operation such that a single antenna system can serve both frequency sets.

[0073] An important characteristic of my inventive telephone depicted in **FIG 4** is the simultaneous use of multiple handsets. For example, and with continued reference to **FIG. 4**, when a wireless call is active at the stationary-mobile base **800** such that it is communicating with a cellular base station (not shown) servicing the particular cell in

which the stationary-mobile base **800** is situated, multiple users can be on that same call using **type-1** or **type-2** handsets, all automatically configured to operate in cordless mode and communicating with the cordless sub-system within the base. Furthermore, if a user in the same business office or household has a need to get on a different call, any of the **type-2** handsets **820-1** or **820-2** can be switched to cellular mode manually using its own cellular telephone number - which is in this case is different from the cellular telephone number of the base **800**. When any of the **type-2** handsets moves sufficiently away form the base, where the cordless RF signals are out of useful signal reach, the type-2 handsets may automatically switch to a cellular phone with their own telephone numbers unless the user has disabled this feature.

[0074] Further features and advantages of our inventive telephone and method can be understood with reference to **FIG. 4a** where it is shown how base **900** of a **dual un-mobile-telephone** can be used with three types of handsets. As shown in **FIG. 4a**, the base **900** has a provision for two antenna systems **968** and **969**, one for each mode of operation, cellular and cordless. As can be readily appreciated, the dual un-mobile-telephone includes aspects of our inventive **stationary-mobile** and **un-mobile** telephones described earlier in **FIGs 2** and **3** respectively.

[0075] With specific reference to **FIG 4a**, a **type-3** handset **969** is attached to base unit **900** by a cord **953** which operation is as described during the discussion of **FIG 3**. Handsets **901** and **920** are **type-1** and **type-2** handsets. Since handset **920** is a **type-2** handset, it contains contain both cellular and cordless sub-systems and it incorporates two antenna systems **977-2** and **978**. Conversely, handset **901** contains

only a cordless sub-system and therefore only requires the cordless antenna system **977-1**. The communication between the base **900** unit and the handsets **901** and **920** is as described during the discussion of **FIG. 4** for the **stationary-mobile base unit** and the **type-1** and **type-2** handsets shown therein. Lastly, and although in this **FIG. 4a** only one type-1 and one type-2 handsets are shown, other combinations are also possible and contemplated.

[0076] We now turn our attention to **FIG.5**, which shows a block diagram of our inventive telephone and in particular the base portion of a **stationary-mobile-telephone** system or, similarly, the base of the **dual un-mobile telephone**. At a high level, the block diagram shows two complete sub-systems, a cellular sub-system and a cordless sub-system, along with functions shared by both sub-systems. Of course, it should be noted that each block in **FIG.5** could be made up of more than one integrated chip (IC). Alternatively, the multiplicity of functional blocks could be integrated onto a smaller number of physical integrated circuits, depending upon specific implementation choices.

[0077] With continued reference to that **FIG 5**, the cellular sub-system shown therein includes: antenna **113**, cellular radio block **125** which includes RF receiver and transmitter (not shown separately), analog & digital block **124** which performs such functions as Analog-to-Digital (A/D) conversion, digital-to-analog (D/A) conversion, digital signal processing, radio control and interface and other. In a typical embodiment, radio block **125** along with the antenna **113** provide the functions necessary to transmit and receive RF signals to and from a wireless/cellular base

station servicing the cell where the **stationary-mobil or dual un-mobil base unit is** located. As can be readily understood, radio **125** and the entire cellular sub-system may comply with any or multiple of the most widely available wireless standards today including CDMA, GSM, TDMA, WCDMA, AMPS PHS, PDC, PHS and their derivatives which operate in the spectrum allocated for cellular telephony, generally, 800MHz, 900MHz, 1800MHz and 1900MHz - depending on the standard. Additionally, cellular sub-system includes master microprocessor **124** (□P) & control circuits **126** which collectively control the major and functions and state of the telephone. Memory **130**, which could be comprised of both RAM (Random Access Memory) and Flash Memory (Read and Write non-volatile memory), is used to store program software code and/or other user defined or code defined parameters necessary for operation. Lastly, □P **126** may also control the user interface functions namely, key matrix **127**, LEDs **128**, LCD **129** and voice codec **121** (Coder-Decoder). As is known in the art, codec **121** is used to encode voice signals and thereby convert audio signals to their digital form and vice versa so that they can be processed by the signal processor, **124**.

[0078] With continued reference to **FIG 5**, the cordless sub-system shown therein comprises functional blocks similar to those in the wireless/cellular sub-system namely, radio **123** and antenna **110** which transmit and receive cordless frequency RF signals to and from **type-1 (801-1**, **801-2** and **801-3**) and **type-2** (**820-1** and **820-2** handsets). Of course, radio **123** operates in that portion of the electromagnetic spectrum allocated for cordless communications of which the most widely frequencies used are 46/49MHz which primarily use FM modulation and 900MHz, 2.4GHz or 5.8GHz which primarily use digital frequency hopping modulation.

[0079] At this point it is important to note that my inventive telephone is not limited to the use of cordless links such as those identified above, but advantageously, other links such as 802.11 (wi-fi), bluetooth, or wireless infrared would suffice as well.

[0080] Returning now to **FIG 5**, the cordless sub-system also includes analog & digital processing functions **114** and slave μP & control circuits **115**, which while it controls and provides programming in the cordless sub-system, acts as a "slave" in the two-μP overall system. Along with the μP **115** is its associated memory **116** which stores program code and parameters associated with cordless operation.

[0081] The functional systems shown in **FIG. 5** which are common to both cellular and cordless sub-systems comprises the power supply **131** which includes a battery (not shown) and circuitry associated with the AC-DC adapter **157** shown in **FIG.2**. Additional common elements include an optional microphone **120** and optional speaker **119** are shown for those embodiments of my inventive telephone that utilizes a hands-free speakerphone. Audio (analog) switches **122-1**, **122-2** and **118** route audio signals to either the base's built-in speakerphone or to the handsets via the cordless subsystem. Antenna sub-system **112** is employed when the frequencies of operation of the two sub-systems, the cellular and cordless, are close enough that a single antenna **111** can serve the two sub-systems. When used, antenna sub-system **112** combines or splits RF signals using RF switches and RF filters (not shown). Of particular importance to my inventive telephone is the dial tone generator **117**, which generates a dial tone in response to a user's initiation of a call. The cordless-presence system 134, contains

specific coding information that indicates to either µP (115, 124) whether any handset of **type-1** or **type-2** is/are within effective range of the base's cordless sub-system.

[0082] During an active telephone call both the cellular and cordless sub-systems of **FIG. 5** are active simultaneously. Special design considerations prevent interference between the two radios **123** and **125** and the two antenna systems **110** and **113**. In the receive direction of a voice call, the associated signal is directed from the base station to the cellular antenna **113**, processed and routed through the cellular sub-system's receiver and directed to the cordless sub-system's transmit path where it is sent via the cordless antenna **110** to a **type-1** or **type 2** handset's cordless receiver sub-section (**225** in **FIG. 6**) where it is eventually routed to an earpiece (**219** in **FIG. 6**).

[0083] With simultaneous reference now to **FIG 5** and **FIG 6**, in the transmit direction, a voice signal begins at a handset's microphone **220,** is processed and routed to the transmit section of the handset, sent out the handset's antenna **210**, received then by the base's cordless antenna **110 (FIG 5)** processed and routed by the cordless sub-system receiver and routed to the transmit circuitry of the base's cellular sub-system where it is send out via cellular antenna **113** to the cellular base station communicating with the cellular sub-system of the telephone. If the base speakerphone is active, that is, microphone **120** and speaker **119** are on, the cordless sub-system of the base is in standby mode thus preventing the signal from being routed to any handset.

[0084] With reference now to **FIG 6**, there is shown a block diagram of my inventive **type-2** or alternatively a handset which contains both cellular and cordless functions (**duocell**). The telephone shown in **FIG 6** includes two complete sub-systems, a cellular and a cordless, with some components shared by both sub-systems. The cellular sub-system includes an antenna **213**, cellular radio system **225** which includes RF receiver and transmitter (not shown separately), and analog & digital system **224**.

[0085] When a **type-2** or **duocell** handset such as that depicted in **FIG 6** is in cellular mode, it function as a stand-alone cellular telephone. Before beginning my discussion of this **FIG 6** however, it is important to note that a **duocell** telephone according to my inventive teachings is NOT associated with a base unit however the functional blocks depicted in **FIG. 6** are nevertheless applicable. Accordingly, references made to a base unit in the remainder of this **FIG. 6** description is not applicable to the **duocell** telephone. Additionally, the software programming of the **duocell** telephone is slightly different form that of the **type-2** handset and it is described later.

[0086] Advantageously my inventive **type-2** handset may be switched manually to a desired mode of operation – either cellular or cordless - through the action of Cell/Cordless switch **234**. Radio block **225** in conjunction with antenna **213** transmit and receive RF signals to and from a cellular/wireless base station servicing the cell where the **type-2** handset is located. As with the cellular sub-system in the base described with reference to **FIG. 5**, the radio **225** and the cellular sub-system may

comply with any or a mix of the most widely available wireless standards. In addition, the cellular sub-system of a type-2 handset includes microprocessor (□P) & supporting control circuits **226** which controls the major functions and state of the **type-2** handset when in cellular mode, a memory **230**, which may include both RAM (Random Access Memory) and Flash Memory (Read and Write non-volatile memory), that stores the program software code and other user defined or code defined parameters. The □P **226**, when in cellular mode, controls the user interface, key matrix **127**, LEDs **128**, LCD **129** and voice Codec **221** (Coder-Decoder).

[0087] When not in cellular mode (cordless mode), the cordless sub-system takes over operation of the type-2 handset while the cellular sub-system enters standby mode. As shown in **FIG 6**, the cordless sub-system includes radio **223** and antenna **210** which transmit and receive cordless frequency RF signals to and from a cordless base (not shown). As is known in the art, radio **223** operates in the spectrum allocated for cordless communications and is not limited to common cordless frequencies, but could also use other known links such as 802.11, Bluetooth or others. Other elements of the cordless sub-system include analog & digital processing system **214**, and cordless □P & control circuits **215**.

[0088] Functional systems shown in **FIG. 6** and which are common to both cellular and cordless sub-systems include power supply **231**, microphone **220** and earpiece **219**. An audio (analog) switch **232** routes the audio signal to the common codec **221**. In operation, the audio signal originates either from the cellular or cordless sub-system. The antenna sub-system **212** is optional and a matter of design choice is

used when the frequencies of operation of the two sub-systems, the cellular and cordless, are close enough that a single antenna **211** can be used for both wireless and cordless communications thereby eliminating the need for two separate antennas for each of the two sub-systems. Since the simultaneous operation of cordless and cellular sub-systems ever takes place, the antenna sub-system **212** is simplified.

[0089] Importantly, cordless RSSI system **233** evaluates the signal strength from the base to the handset to determine whether it is appropriate to switch from cordless to cellular operation. In particular, when a handset such as that shown in FIG 6 is moving geographically away from a cordless base station, the RSSI system continually evaluates the signal strength between the base and the handset. If the cordless signal strength falls below a pre-determined, acceptable level, the RSSI system **233** automatically switches the handset into cellular/wireless mode. Lastly, cordless ID system **216** provides a unique identifier for the handset which is typically defined at time of manufacture.

[0090] During an active telephone call while in cellular mode, a **type-2** handset such as that shown in **FIG 6** functions like a conventional cellular telephone communicating with a cellular/wireless base station servicing the cell where the **type-2** handset is situated. Alternatively, when in cordless mode, the receive signal path begins at a base's cellular antenna (**113** in **FIG. 5**), processed through the receive circuits of the base's cellular sub-system routed to the base's cordless sub-system and transmitted via the cordless antenna in the base. The signal is then received at the cordless antenna **210** in the **type-2** handset, processed by radio **223** and signal

processing system **214** and then routed to earpiece **219**. In the transmit direction, a voice signal originates at microphone **220**, is processed and routed to the transmit section of the handset **214**, **223**, transmitted via antenna **210**, and subsequently received by the base station's cordless antenna (**110** in **FIG 5**). The signal is then processed and routed by the cordless sub-system's receiver (**123** and **114** in **FIG. 5**), routed to the transmit circuitry of the base's cellular sub-system (**124** and **125** in **FIG. 5**), where it is send out via cellular antenna (**113** in **FIG. 5**) to the cellular/wireless base station communicating with the cellular sub-system of the handset.

[0091] With reference now to **FIG. 7**, there is shown a block diagram of my inventive **type-1** handset. As can be readily observed by inspection of that **FIG 7**, the type-1 handset includes a cordless system but not a cellular/wireless system. In a representative application, such a handset is active when the user selects this specific handset to originate or receive a telephone call.

[0092] As can now be appreciated, a **type-1** handset functions in a similar manner to the cordless sub-system of a **type-2** handset. Major functions provided in a **type-1** handset include: radio **323**, antenna **310** where RF signals are received and transmitted from and to the a **stationary-mobile-telephone** cordless sub-system. Radio **323** operates in the spectrum allocated for cordless communications of which the most widely frequencies used are 46/49MHz primarily using FM modulation and 900MHz, 2.4GHz or 5.8GHz primarily using digital frequency hopping modulation.

[0093] Shown also in the cordless system of type-1 handset is analog & digital processing system, **314**, μP & control circuits system **315**, which programs and controls all functions in the cordless system. As should now be apparent, the □P controls the keypad **327**, LEDs **328** and display **329**. Codec **321**, microphone **320**, earpiece **319** and power supply **331** perform the same or similar functions as those described earlier during the discussion of the **type-2** handset. Similarly, signal and voice paths, whether in the transmit or receive direction, are routed in a manner described previously.

[0094] With the functional elements of my inventive telephone described, it is now appropriate to focus on the logical operation of my invention. With reference now to **FIG. 8**, there is shown a flow chart that illustrates major steps performed by software within the a base or a **type-2** handset is automatically switched from cellular to cordless modes and vice versa.

[0095] Specifically, step **S301** begins after a **type-2** handset is turned on, and an initialization routine step **S302** subsequently begins between the handset and a base of the **stationary-mobile-telephone**. During this initialization, the handset transmits to the base its unique ID, and a unique serial number stored in the handset's flash memory. The base records and stores the IDs of all handsets, whether **type-1** or **type-2**, associated with it. After synchronization and initialization is established, the base begins sending messages out sequentially, called polling, in cordless frequencies alternating between the various IDs established during initialization. These polling messages may be sent out every 10 seconds or so.

[0096] Each **type-2** handset monitors, at step **S303**, the polling messages from the base and if one matches the handset's own ID at step **S304**, the handset remains or switches to cordless mode unless the type-2 handset is forced manually into cellular mode at step **S306**. Although not shown in the flow chart, the handset replies back to the base with its ID number.

[0097] If, at step **S304**, a polling message is not detected or does match the handset's own ID, the handset switches to cellular mode and start operating as a cellular telephone while the cordless sub-system in the type-2 handset goes into standby mode.

[0098] **FIG. 9** is a flow chart depicting an extension of the flow chart shown in **FIG. 8** and illustrates a scenario when a **type-2** handset is in cellular mode while approaching the residence or business office where its base is located.

[0099] As shown at step **S401**, the **type-2** handset is in an active cellular call and as described in **FIG. 8** its cordless cub-system is in standby mode, step **S402**, but still detecting polling messages. Regardless of its proximity to its base as shown at step **S403**, the **type-2** handset remains in cellular mode for as long the wireless call is active as shown at step **S404**.

[00100] If the **type-2** handset had been set to cellular mode manually using cellular/cordless switch, as shown at step **S405**, polling/monitoring by the handset is terminated. Once the manual cellular/cordless switch is in the automatic position, the

type-2's cordless sub-system begins monitoring the polling messages from the base as shown at step **S406**.

[00101] If, as determined at step **S407**, a poling message is received by the type-2 handset containing its own ID as described earlier in **FIG. 8**, the handset switches automatically to cordless operation and communicates with the base's cordless sub-system.

[00102] **FIG. 10** is a flow chart according to the present invention that illustrates a method of assigning the same telephone number to two cellular phones. In the context of the earlier described embodiments, a cellular sub-system of a base (**700** of the **stationary-mobile-telephone** shown in **FIG. 2**) may serve as the first cellular phone while the cellular sub-system of the **type-2** handset (**701** also shown in **FIG. 2**) may serve as the second cellular phone for the purposes of our example.

[00103] Specifically, and with reference to **FIG 10**, Initialization and synchronization with the handset is performed at step **S502** after the base is powered on at step **S501**. Such initialization is the generally the same as that described during the discussion of **FIG. 8**. Subsequently, at step **S503**, the base begins sending the polling messages (in cordless mode) from which it is expected to receive a reply from each of the handsets provided the handsets are in sufficiently close proximity such that they fall within range of the cordless frequency transmission and reception.

[00104] At step **S504**, a determination is made whether at least one handset is detected by the base, whether **type-1** or **type-2**, the base's cellular sub-system remains active as shown at step **S505** i.e., the cellular sub-system of the **stationary-mobile-telephone** is listening to incoming paging from the base station.

[00105] If, at step **S504**, no handset is detected by the base, the base shuts down its cellular sub-system at step **S506** and sets its cordless sub-system to standby mode at step **S507**. Provided that a "designated" **type-2** handset is assigned the exact same phone number by the wireless service provider as that assigned to the cellular sub-system in the base, this "designated" **type-2** handset, which also detected the absence of its base as described in **FIG. 8**, had converted to cellular mode with the same telephone number.

[00106] As shown in step **S508**, the cordless sub-system in the base wakes up and sends polling messages to its handsets at step **S509**. If and only if the "designated" **type-2** handset returns to the base as shown at step **S510**, only then does the base re-activates its cellular sub-system at step **S505**.

[00107] As can now be appreciated, the above method ensures that only one of the two cellular sub-systems - either the base or the type-2 handset - is operational at any given time thereby effecting the assignment the same phone number to two cellular phones.

[00108] Turning our attention now to **FIG. 11**, there is shown a flow chart which illustrates an alternative method of assigning the same phone number to two cellular

phones, according to my inventive teachings. As was the case before, the two cellular telephones for our illustrative purposes may comprise the cellular sub-system of the base and the cellular sub-system of the **type-2** handset.

[00109] Initialization and synchronization with the handset begins at step **S602** subsequent to the base being powered on at step **S601**. The initialization is the generally the same as that described previously with respect to **FIG. 8**, i.e., during initialization, the handset transmits its unique ID, a unique serial number stored in the handset's flash memory to the base. The base records and stores the IDs of all handsets, whether **type-1** or **type-2**, associated with it.

[00110] After synchronization and initialization is established, the base begins sending messages out sequentially, polling, in cordless frequencies alternating between the various IDs established during initialization. The base begins sending the polling messages (in cordless mode) at step **S603** and expects to receive a reply from each of the handsets provided the handsets are in sufficiently close proximity and within effective range of the cordless frequency transmission and reception.

[00111] If, at step **S604**, at least one handset is detected by the base, whether **type-1** or **type-2**, the base's cellular sub-system remains active as shown at step **S605** i.e., the cellular sub-system of the base of the **stationary-mobile-telephone** it is listening to incoming paging from the base station.

[00112] Conversely, if, at step **S604**, NO handset is detected by the base, the base automatically activates its call forwarding feature, as shown at step **S606**, to direct the call to a "designated" **type-2** handset. It should be noted that in this case the base's cellular sub-system has a different phone number from the handset's cellular sub-system. If the base's cellular sub-system is active or the designated **type-2** handset returns to the base, the base de-activates the call forwarding feature as shown at step **S610**.

[00113] Returning now to step **S606** where the base activated its call forwarding feature, in the absence of any handsets near the base, the base also set its cordless sub-system in standby mode step **S607**. Every 10 seconds or so (step **S608**) the base then sends polling messages (step **S609**) to the handsets and if any are detected at any given time, the base de-activates its call forwarding feature.

[00114] Advantageously, the call forwarding feature can be set manually by the user to direct the call to any **type 2** handset (or any phone number for that matter). Additionally, the above method for automatic call forwarding can be disabled by the user, if desired.

[00115] **FIG. 12** illustrates in flow chart format a method depicting how a cellular telephone of virtually any wireless technology (GSM, CDMA...) can generate a **cell tone** (dial tone) according to my inventive teachings. Since this application is more practical in cellular telephones used in fixed locations and for simplicity of explanation, the description of **FIG.12** only makes reference to the **stationary-mobile-telephone**

and the **un-mobile** telephone systems. It should be noted, however, and as can be readily appreciated by those skilled in the art, that this method is applicable to any cellular telephone system including the **dual un-mobile** and **duocell** telephones.

[00116] Because both, the **stationary-mobile** and **un-mobile telephones** are expected to be stationary, the generation of cell tone is an important aspect of my inventive concepts since it provides a user with the perception that he/she is using a landline phone (POTS) while in actuality wireless service is being used. The physical look and feel of an **un-mobile** or **stationary-mobile telephones** also contributes to the perception that a wireline/landline service is being employed. Consequently, throughout the rest of the description of **FIG. 12**, the term "base" will refer to the base of the **un-mobile** or **stationary-mobile** telephones.

[0100] With reference now to that **FIG. 12**, at step **S901** a user is getting ready to dial a number either by lifting the **type-4** handset of the **un-mobile**, depressing the "talk" button of a **type-1** or **type-2** handset or by pressing the "speakerphone" button of the **un-mobile** or **stationary-mobile** telephones. While not shown specifically in the earlier described **FIG. 2** and **FIG 3**, "talk" and "speakerphone" buttons are generally known in the art and as such could be readily implemented in the configuration(s) shown in those FIGs.

[0101] At step **S902** the cellular sub-system of the un-mobile or stationary-mobile bases determines whether there is wireless service available in the area i.e., whether the telephone has adequate reception of the RF signals from the nearby base station.

Received signal strength measurements and digital signal processing at step **S902** determine whether the cellular sub-system is capable of initiating a call. If no wireless service is available or no outgoing call capability is determined, no **cell tone** is generated as shown at step **S904** and the user is unable to make a call as shown at step **S908**.

[0102] If, at step **S902**, wireless service is available AND the received signal strength from the base station and signal processing indicate that a call is possible, the **cell tone** is then generated at step **S903** by the base's internal circuitry i.e., block **117** in **FIG. 5** and then sent to the **type-1** or **type-2** handsets via the cordless link or through the speaker of the base if speakerphone operation is selected or a **type-4** handset is being used.

[0103] According to one aspect of my inventive concepts, when the user dials a number, the digits are NOT automatically sent one by one to the cellular sub-system of the base. Instead, they are stored in RAM by the cordless sub-system of the base as shown at steps **S910**, **S911** and **S912** until the user is done dialing.

[0104] By way of example, if the user dials a 3-digit number such as 911 or 411, the base (cordless sub-system) compares - at step **S914** to - determine whether this 3-digit number is valid i.e., all known valid 3-digit numbers reside in Flash memory. If the 3-digit number dialed is valid, the cordless sub-system sends the number, at step **S918**, to the cellular sub-system which, in turn, is dialed out to the wireless network.

[0105] On the other hand, If the 3-digit number dialed is not a match with the valid 3-digit numbers contained in Flash memory, the cordless sub-system waits for substantially 7 seconds as shown at step **S913** and then again sends the dialed number to the cellular sub-system. As determined at the next step, step **S917**, if the call is successful, the dialed 3-digit number becomes a valid number and is stored in Flash memory at step **S921** to be used for future 3-digit comparisons. If the call is not successful, the cellular sub-system defaults to the message received from the wireless network as shown at step **S922**. As can be appreciated, the telephone according to my inventive teaching, "learns" which 3-digit numbers are in fact valid.

[0106] Returning now to the flow chart of **FIG. 12**, at step **S906**, if a 10-digit number (area code + 7 numbers) is dialed after the cell tone is generated at step **S903**, the number is again stored temporarily in the base's cordless sub-system at step **S911** and then send to the cellular sub-system at step **S917** which in turn sends the number to the wireless network and then defaults to the result form the network at step **S919**.

[0107] If, at step **S906**, a 7-digit number is dialed by the user, the cordless sub-system base adds its own area code (the cordless sub-system knows the cellular sub-system's own phone number) at step **S915** and then sends the number to the cellular sub-system and then defaults to the wireless network at step **S919**. As can be appreciated, such a feature eliminates the need for a user to enter area codes in the local area, thereby relieving the user from necessarily providing such information.

[0108] Continuing, if any other number of digits is dialed (other than 3, 7 or 10) as shown at step **S907**, the cordless sub-system of the base saves the number in RAM (step **S912**) and then sends the number to the cellular sub-system after a delay of substantially 7 seconds as shown at step **S919** and then defaults to the wireless network at step **S920**. Although not specifically shown in the flowchart of **FIG 12**, after step **S916**, if a successful call was completed, the dialed number is stored in flash for future comparison such that the substantially 7 second delay is eliminated. Likewise and again not shown in the flowchart, at step **S915** after the addition of the cellular sub-system's area code to the 7-digit dialed number, if the call is successful the 3-digit local exchange number (ex. 555 in 555-1212) is stored in Flash for future numbers dialed. Finally, it should be mentioned that the substantially seven (7) second delay described above is variable and is chosen here for example. If, more desirable delay, either longer or shorter is determined to be useful as a result of human factors or other considerations, our inventive method can be modified to provide such longer or shorter delay.

[0109] With reference now to **FIG. 12a**, there is illustrated an alternative method of generating **cell tone** (dial tone), when a traditional cellular is used, along with automatic completion of a partially number being dialed, the elimination of the "send" button and the automatic insertion of the area code or other prefix if the phone is used in countries other than the US. Each of these capabilities would reinforce the user's perception of having a wireline connection whereas in actuality cellular telephony is being used. These features are particularly important in fixed location cellular telephones systems such as the **stationary-mobile, un-mobile or the dual un-mobile**

**telephones.** It should be pointed out that the two features of automatic completion of a partially dialed number and the elimination of the need to include the area code (n certain cases) are not limited in cellular telephone applications but also in all telephones including T/R analog wireline, ISDN, cordless or any other interface wired or wireless.

[0110] With reference now to **FIG 12a**, there is shown a flow chart depicting my inventive method of operating a wireless/cellular telephone. To summarize the inventive method depicted in **FIG.12a**, a dial tone is generated when the cellular telephone determines that a sufficiently strong RF signal from the nearest base station (BS) is present. As a user dials digits, the cellular telephone's software determines whether the dialed digits and their relative position match any digits of a number corresponding to a previously and successfully made call which is already stored in the memory of the cellular telephone. If a match is made, the matching number is completed automatically by the telephone and displayed. If more than one match is found in memory, the matched numbers are displayed according to a pre-defined priority – i.e., based on their history of most often called. The user may then select the number of choice with a specific arrow button. If no match is found, the number the user dials is sent out to the wireless network substantially 7 seconds (again, variable depending upon human factors) after the last digit of the number is dialed. If this call is successful, the number - including its area code - is stored in memory for future use.

[0111] As can be appreciated, this inventive method may be adjusted to accommodate different prefixes for different countries as it has the ability to "learn" numbers and prefixes. Regardless of the number of digits dialed, the cellular telephone

will send out to the wireless network any pre-determined number of digits substantially 7 (or other) seconds from the last digit dialed. Advantageously, this combination of dial tone, timing information and storage of numbers in memory allow for the elimination of the "send" button in cellular telephones.

[0112] As can be readily appreciated by those skilled in the art, with cellular telephony as presently implemented, the "send" button is that button pressed after a complete number is dialed including the area code (US or North American Dialing). Because there is no need for a "send" button, only a "talk" or equivalent button is necessary; similar to that of cordless telephones.

[0113] With continued reference now to **FIG. 12a**, step **S701** indicates that the device being used is any suitable wireless technology (GSM, CDMA, WCDMA, PHS, PDC, OFDM or other) cellular telephone. As can be appreciated, step **S701** includes the fixed location cellular phone systems, **stationary-mobile**, **un-mobile** and **dual un-mobile** described herein, along with the specialized **duocell** phone.

[0114] At step **S702**, a user gets ready to make a telephone call by pressing the "talk" button or equivalent button of the cellular telephone. At step **S703**, the digital signal processing (DSP) system of the phone calculates the (BS) base station's RF signal strength to determine wireless service is available and/or usable for the call.

[0115] As can be appreciated, in a specific embodiment of the present invention wherein a signal strength indicator integrated into the telephone, the user can

determine, visually or otherwise, the possibility of a call origination by assessing the signal strength which is generally a measure of RF signal energy from the nearest BS, although this is not always accurate. If it is determined that a cellular call is warranted, **cell tone** (dial tone) is generated by the phone's internal circuitry at step **S706**.

[0116] If no wireless service is available in the area or if phone's DSP determines a weak reception of RF energy from the BS, no **cell tone** is generated as shown at step **S704** and the user is unable to make a call as shown at step **S705**. In this case an error tone is generated by the phone and, in a preferred embodiment, a no-call-possible or equivalent message may be presented to the user, i.e., on the phone's display.

[0117] When the dial tone is generated at step **S706**, a count of 1 is set for a software variable (N) in the algorithm expecting the user to dial the first digit. As the user dials digit after digit, as shown at step **S707**, the algorithm compares, at step **S708**, the digits dialed so far to any numbers previously stored in the phone's memory to determine whether there is a match. As noted earlier, the numbers stored in memory are typically those numbers successfully completed in previous calls. Additionally, at step **S708**, the number being dialed is compared up to the first three (3) digits dialed for any match in both the area code and 3-digit local exchange. If a match is found, the algorithm shows the completed number (s), at step **S709**, on the phone's display 721.

[0118] The number of telephone numbers displayed is a matter of implementation based on several factors such as display (LCD) size, character size, selectable user preference or other. The numbers displayed are shown in order of a

pre-determined priority, i.e., the number called the most times in the history of the phone appears first on the list.

[0119] With continued reference to the display **721** of **FIG 12a**, there is shown a dialing example. In this example, the user only dialed the local exchange number "231" (Ref # **719**), without the area code. Because there were no numbers in memory having a "231" area code, the algorithm displayed the complete numbers in memory that matched the local exchange including the area code **720**. As shown, if there is match for both local exchange and area code, the area code takes precedence. If there is no history of numbers in memory, no match is found and therefore nothing is displayed. When numbers are displayed, the user has the option to select which number to dial out without pressing the rest of the digits as shown at step **S711**. The number is then sent out to the wireless network at step **S713**. If the call is successful, at step **S715**, the number is automatically stored in the phone's memory, step **S714**, unless of course it is already in memory. In either case the number's priority is increased by a count of 1 for future comparisons of numbers most often called. If the call does not go through, the phone defaults to the wireless service message and nothing is stored in memory.

[0120] Returning our examination with step **S708**, if the user waits more than substantially 7 seconds to dial the next digit, as shown at step **S710**, the number of digits dialed up to this point will be sent out to the wireless network and proceed again through steps **S715** and **S714** to determine if the call was successful and be stored in memory or default to the wireless network message at step **S716**. If subsequent button presses are less than 7 seconds apart, the algorithm proceeds through step **S717** to

determine whether enough digits have been dialed (N equals X) to sent the number out without added delay and wait time or to allow the user to proceed pressing the next button as shown at step **S707**. As noted earlier, the substantially 7 seconds specified herein is only a guide and can be changed as required based on country, specific segment of the population or other factors.

[0121] Step **S717** provides the telephone with the ability to “learn” telephone numbers. As can be readily appreciated by those skilled in the art, telephone numbers always have a last digit, defined in the algorithm as X. For example, X can be 10 based on the fact the in the North American Numbering Plan, a telephone number consists of a 3-digit area code, a 3-digit local exchange and four other numbers for a total of 10 digits. If a user dials, for example, a 7-digit number without the area code and there is a match in memory including the area code, the algorithm recognizes that and dynamically sets X equal to 7, automatically adds the area code and send out the number, step **S712**, without any delay or wait time. Furthermore, if a user dials a 7-digit number, again without the area code but there is no such number in memory, the algorithm adds the phone’s own area code and sends the number out as shown at step **S712**. To avoid erroneously dialing out the wrong number, timing information between key presses is also advantageously employed by the algorithm.

[0122] Special numbers such as 911 or 411 are recognized by the algorithm at step **S717** in conjunction with memory by setting X equal to 3 and sending out the number immediately. This algorithm along with timing information may be varied such that it is “optimized” for a particular implementation. Advantageously, the algorithm is

applicable in a cellular system in any country as it can be programmed to accommodate the telephone numbering scheme in that country.

[0123] With reference now to **FIG. 12b,** there is shown how different telephone systems, that include a redundant or secondary radio or air link sub-system, can be used for a multitude of applications. The secondary radio or air link can be of any type including cordless, 802.11, blue tooth, infrared or other. For simplicity, it will be assumed for the remainder of this discussion that the specific implementation utilizes cordless at 2.4GHz. Reference to a **dual function phone** for the remainder of this description means any of the telephones systems described herein.

[0124] The telephone types shown in **FIG. 12b** include a **duocell 452** which is a cellular telephone having one of a number of wireless technologies such as GSM, CDMA, PDC etc but also includes a secondary radio that uses cordless technology at, for example, 2.4GHz. Consequently, this phone includes two antenna systems, cordless **450-2** and cellular **451-1**. The secondary radio, while redundant is this phone, may advantageously be used to communicated or control some other remote device.

[0125] The base unit **454** of the **stationary-mobile, un-mobile** or **dual un-mobile** telephone systems is another device that includes both cellular and cordless sub-systems along with cellular and cordless antenna systems **451-2** and **450-3** respectively. Although the cordless sub-system in the base unit **454** is intended to communicate with handsets, advantageously it may be programmed such that it can communicate with handsets and control another device.

[0126] Also shown in **FIG. 12b** is a traditional cordless telephone **453**, having only a single, cordless antenna system, **450-1**. And even though cordless telephone **453** only includes a single radio system and a single antenna system **450-1**, it can also be programmed to send different messages – as distinguished from those it sends to its handsets - in order to control other devices. Lastly a wireline Tip/Ring T/R (POTS) telephone may be equipped with a cordless radio sub-system and its antenna **450-8** to communicate with remote devices as well.

[0127] One of many applications of these inventive **dual function phones** is alerting a user of an incoming call in a variety of ways. For example, the **remote-auditory-alert 455** may be used in those situations where the user is away from the phone or if the user is hearing impaired. The remote-auditory-alert device **455** may advantageously include the same technology air link as the dual function phone, in this case a cordless system and its antenna **450-4**. Software programming and a handshaking algorithm is used in the communication protocol between the remote device **455** and the dual function phone such that the remote device is activated at appropriate times.

[0128] Other methods for remote alerting include the **remote-visual-alert** device **456** having a cordless antenna **450-5** and the **remote-motion alert** device **457**. Remote visual alert device **456** may be used by hearing impaired individuals or in high background/ambient noise environments where visual notification is necessary or otherwise desirable. As can be readily appreciated by those skilled in the art, such a

remote visual alert device may employ a blinking light or a more sophisticated array of lighting patterns. Additionally, the motion alert device **457** may be a signaling device that employs a mechanical motion, i.e., a spinning propeller, or other, that can be set in motion by signaling information transmitted from the dual function phone.

[0129] Of special interest to my invention described herein is the remote out-of-range alert device **458** which includes a cordless system corresponding antenna **450-7**. It can be used in conjunction with the **duocell** telephone to monitor, for example, a pet or child to ensure they stay within range of the cordless sub-system of the duocell. Specifically, the **duocell** phone may be programmed such that an alarm or other indicator notifies the user when the device **458** goes beyond the range of RF communication between the two systems. Two **duocell** telephones can also be used to perform the same function where one of the two is the **master** (parent's cellular phone) while the other is the slave (child's cellular phone). In this case both phones have the ability to make cellular calls but the master duocell has an alarm activated when the slave duocell goes beyond the range of cordless communication between the two phones.

[0130] **FIG. 13** shows a derivative/variation system of the **stationary-mobile-telephone** which we may descriptively refer to as a **"cellcordless telephone".** Specifically, and with reference to that **FIG 13**, the base **981** of the **cellcordless** phone includes a cordless system and communicates with its handsets using the spectrum and technology allocated for cordless communications such as those described prior. The base of the **cellcordless** telephone connects to the landline T/R telephone jack ( not

shown) through its own phone T/R jack **979**. The internal circuit blocks of the base are very similar to those in **FIG. 7**. The base antenna **980** is designed to operate only in cordless frequencies.

[0131] One difference between the **cellcordless** telephone of **FIG 13** and a cordless telephone is that the cellcordless base includes software and algorithms to perform those inventive functions as were described with reference to FIG. 8 and **FIG. 9**, that is, the detection of its handsets present. Such detection functions are required, according to my inventive teachings, because the **cellcordless** phone can interact with standard cordless handsets (**type-1**) **990-1**, **990-2** and **990-3** as well as **type-4** handsets, **991-1** and **991-2**. As noted before, **type-4** handsets are similar to **type-2** handsets but only have to interact with a cordless-only base. As such, antennas **983-1**, **983-2** and **982-4**, **982-5** operate in cellular and cordless modes respectively.

[0132] As can be appreciated, and while recalling those methods depicted in **FIG. 8** and **FIG. 9** those algorithms show there are applicable to the type-4 handset such that it can switch from cordless mode when close to its base or become a stand-alone cellular telephone (with a different number from that of the base) when away from its base **981**, as taught by my inventive teachings.

[0133] As can now be appreciated the **cellcordless** phone may advantageously be used in areas where no wireless coverage exists, but the same handset could be used when leaving a residence or an office.

[0134] At this point, some additional aspects of my invention become apparent. In particular, a **stationary-mobile-telephone** having **type-2** handsets can be constructed such that when a caller calls a phone number of the base unit, all handsets within a useful range of the base unit as well as the base unit ring (alert). In addition, if the telephone number of a **type-2** handset cellular telephone is called, and it is assumed that the **type-2** handsets have different cellular phone numbers from that of the base unit and from one another, then only the handset whose phone number is being called will ring.

[0135] With reference now to **FIG 14.**, there is shown a **stationary-mobile-telephone** having a base unit **767** and two **type-2** handsets **766-1** and **766-2**. Of course, and as can be readily appreciated, any number and combination of **type-2** and **type-1** handsets is possible. Additionally, and as noted earlier, base unit **767** of the **stationary-mobile-telephone** has both cellular and cordless sub-systems which communicate via RF signals using antenna systems **768** and **769** respectively. The two **type-2** handsets, **766-1** and **766-2**, each also include cellular and cordless subsystems that communicate with a serving cellular base station (not shown) via antennas **751-1** and **752-2** and with a base unit via cordless frequency RF signals using antenna systems **750-1** and **750-2** respectively.

[0136] When made service operational, the base unit is assigned a distinct telephone number by a serving wireless service provider. Additionally, since the two **type-2** handsets **766-1** and **766-2** also include cellular and cordless subsystems communicating with the base unit with cordless frequency RF signals using antenna

systems 750-1 and 750-2 when near the base unit, while communicating with nearest base station with cellular RF signals using antenna systems 751-1 and 751-2 when in cellular mode. In this illustration the two type-2 handsets are assigned different and distinct cellular phone numbers, from each other and the base unit.

[0137] With reference to **FIG. 15**, there is shown a flow chart depicting how a **type-2** handset can be made to alert (ring) when the telephone number of the base unit is called and additionally, when the cellular telephone number of the **type-2** handset is called. Continuing with **FIG. 15**, at step **S701** the cellular telephone number Z of the base unit is called. The base unit then sends an alerting signal to all of its handsets at step **S702**. As shown at step **S703**, all handsets within reach of RF communication from their base unit receive the alerting signal and activate their ringer at step **S705**, unless of course the handset has been manually switched to cellular mode or unless the handset is already on an active cellular call as shown at step **S704**.

[0138] The handset (phone number X) now active on the call with its base unit will remain in cordless mode communicating with the base for as long as the call is active, as shown at steps **S706** and **S707**. All other handsets (cell phone number Y) will be available to receive calls in cellular mode at their own phone numbers. When the call ends as shown at step **S706**, the handset with cell phone number X will alternate between listening to incoming calls from the nearby base station on its own phone number X and listening to polling messages from the base of the **stationary-mobile-telephone** as shown at step **S708**. Similarly, when the call ends, the base unit

will alternate between sending polling messages to its handsets and listening to incoming calls from the nearby base station for phone number Z as shown at step **S709**.

[0139] Step S710 begins the sequence when a **type-2** handset with phone number Y is within RF communication with the base unit of the **stationary-mobile-phone** but receives a call at its own cellular phone number Y. Assuming that the **type-2** handset that receives the cellular call is not already on a call with its base as shown at step **S711**, in which case it is operating in cordless mode step **S712**, the alerter associated with this type-2 handset is activated by its cellular sub-system as shown at step **S713**. If the user answers the call at step **S714**, the handset will remain in cellular mode for as long as the call is active as shown at step **S716** or the user moves away from the base unit. When the call ends, as shown at step **S715**, the type-2 handset alternates listening between its own base unit for calls to phone number Z as well as listening for incoming cellular calls to its own number Y (from the nearby base station).

[0140] A **stationary-mobile-telephone,** as I have described, has the ability to transfer an incoming call at the base unit to any of the cellular phone numbers of its **type-2** handsets when the user does not answer the call and, the wireless service voice messaging system picks up. Advantageously, this is performed through the action of a pre-recorded outgoing voice message that instructs the caller to press a particular number to select which type-2 handset the call should be re-directed to. Of further advantage, the re-directing of the call can be implemented in either the base unit of the **stationary-mobile-telephone** or within the wireless service provider network.

[0141] Alternatively, if the incoming call is answered at the base unit, the person that answered the call can still transfer the call to any of the **typ -2** handsets by pressing the appropriate button corresponding to that particular **type-2** handset. As above, this feature can be implemented <u>either</u> by the base unit of the **stationary-mobile-telephone** <u>or</u> by the wireless service provider's network provided such service feature is added to the system.

[0142] At this point of my discussion, the **stationary-mobile-telephone** of **FIG. 14** with its base unit **767** and its two **type-2** handsets **766-1** and **766-2** will be referred to in explaining the re-directing and transfer of calls. Additionally, it is assumed for our my purposes that the user of the **stationary-mobile-telephone** has pre-recorded an outgoing voice announcement for missed calls to instruct the a caller calling phone number Z to press 1 if the call is to be directed to **type-2** handset with phone number X and to press 2 for the call to be directed to **type-2** handset with phone number Y. Although the call re-direction here is described in terms of a simple key press, advantageously the actual implementation could involve a sequence of key presses, voice recognition or even existing wireless service provider features such as conferencing.

[0143] The call redirection scenario may be readily understood with reference to **FIG.16**. Specifically, at step **S201**, the phone number Z of the base unit is being called and because no one answers the call after a prescribed number of rings, the voice messages system of the wireless network initiates at step **S202** and instructs the caller, via a pre-recorded outgoing announcement, to follow the prompts for the appropriate

action. The owner of the base unit is assumed to have activated the call re-direction feature, step **S203**, either at the base unit of the **stationary-mobile-telephone** (if the base unit implements the call re-direction) or with the wireless network (if the service provider implements the call re-direction). If the voice prompts instruct the caller to leave a message then step **S204** of **FIG. 16** is reached. Otherwise, the caller may press 1, for example, to re-direct the call to cellular phone number X or 2, for example, to re-direct the call to phone number Y for the either of the two **type-2** handsets as shown at step **S205**. As explained above, the instruction prompts for the caller may involve voice recognition or existing network feature instead of simple button presses.

[0144] Continuing with **FIG. 16**, shown therein the scenario of call re-direction after a call is answered. At step **S206**, the phone number Z of the base unit is being called and a user answers the call, at step **S207**, either by using the base unit's speakerphone or using one of the two type-2 handsets, for example, the one with phone number X. Advantageously, it is anticipated that the call re-direction feature can be implemented while the user is on a call as well. The owner of the base unit again is assumed to have activated the call re-direction feature and decides to re-direct the call to phone number Y at step **S208**. If the user took no action to re-direct the call then the call would continue normally as shown at step **S209**. The call re-direction is more complex during an active call at the base unit and would involve timing information between key presses or other actions taken by the user based on the instruction prompts. At step **S210**, the base unit or the wireless network, depending on which entity implements the call re-direction, perform the call re-direction to **type-2** handset with phone number Y.

[0145] Of course, it will be understood by those skilled in the art that the foregoing is merely illustrative of the principles of this invention, and that various modifications can be made by those skilled in the art without departing from the scope and spirit of the invention, which shall be limited by the scope of the claims appended hereto.

WHAT IS CLAIMED IS: